IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Zhidan TOLT	Docket No.:	nanogate120303
Serial No.:	10/707,342	Group Art Unit:	2815
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		Confirmation No.	1341

For: LOW VOLTAGE ELECTRON SOURCE WITH SELF ALIGNED GATE APERTURES, FABRICATION METHOD THEREOF, AND LUMINOUS DISPLAY USING THE ELECTRON SOURCE

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REQUEST FOR CONTINUED EXAMINATION (RCE) & AMENDMENT UNDER 37 CFR § 1.114

Sir:

A Request for Continued Examination (RCE) of the above-referenced application is hereby submitted.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 11 of this paper.

Listing of Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1-39 (Canceled)

40. (Currently Amended) An electron source as recited in claim [[39]]51, wherein said nano-structures are substantially vertical.

41. (Currently Amended) An electron source as recited in claim [[39]]51, wherein said nano-structures are individually spaced apart.

42. (Currently Amended) An electron source as recited in claim [[39]]51, wherein said emitter-to-gate distance for each nano-structure is substantially less than one micrometer.

43. (Currently Amended) An electron source as recited in claim [[39]]51, wherein the nano-structures have a surface density substantially higher than $10^6/cm^2$.

44. (Currently Amended) An electron source as recited in claim [[39]]51, wherein the nano-structures protrude above the surface of the emitting layer for not more than half of one micrometer.

45. (Currently Amended) An electron source as recited in claim [[39]]51, wherein the apertures in the insulator expose the entire protrusion portion of the nano-structures in the emitting layer.

46. (Currently Amended) An electron source as recited in claim [[39]]51, wherein the nano-structures have at least one of their three dimensions in the nanometer range.

47. (Currently Amended) An electron source as recited in claim [[39]]51, wherein the nano-structures include nano-tubes, nano-wires, nano-fibers, and nano-cones.

48. (Currently Amended) An electron source as recited in claim [[39]]51, wherein the nano-structures have a coating for enhanced field emission performance.

49. (Currently Amended) A[[n electron source]] display as recited in claim [[39]]64, wherein the nano-structures are selected from a group of materials consisting of carbon, refractory metals and alloys, conductive ceramics, conductive ceramic composites, and doped semiconductors.

50. (Currently Amended) A display [[An electron source]] as recited in claim 49, wherein the carbon includes carbon nano-tube, carbon nano-fiber, and carbon nano-cone.

51. (Currently Amended) [[An electron source as recited in claim 39,]]An emission electron source comprising:

a cathode electrode disposed on a substrate, the cathode electrode for providing a source of electrons;

an emitter layer disposed over said cathode electrode and formed from a composition of an embedding material and one or a plurality of nano-structures embedded therein, the emitter layer having a surface, portions of the nano-structures protruding above the surface to emit electrons;

an insulator disposed over the emitter layer, the insulator having one or a plurality of apertures, each exposing at least the ends of the nano-structures in the emitter layer; and

a gate electrode disposed over the insulator and having one or a plurality of apertures, wherein each aperture exposes a single nano-structure and is concentrically self-aligned with the end of the nano-structure, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures;

wherein the nano-structures comprise a nonconductive core and a conductive shell.

52. (Previously presented) An electron source as recited in claim 51,

wherein the nonconductive core is made from one of wide band gap semiconductors, including diamond, BN, AlN, AlGaN, GaN, GaAs, SiC, and ZnO.

53. (Currently Amended) An electron source as recited in claim [[39]]51, wherein the embedding material is comprised of at least two layers.

54. (Previously Presented) An electron source as recited in claim 53, wherein the first layer of the embedding material is conductive.

55. (Currently Amended) [[An electron source as recited in claim 39,]] An emission electron source comprising:

a cathode electrode disposed on a substrate, the cathode electrode for providing a source of electrons;

an emitter layer disposed over said cathode electrode and formed from a composition of an embedding material and one or a plurality of nano-structures embedded therein, the emitter layer having a surface, portions of the nano-structures protruding above the surface to emit electrons;

an insulator disposed over the emitter layer, the insulator having one or a plurality of apertures, each exposing at least the ends of the nano-structures in the emitter layer; and

a gate electrode disposed over the insulator and having one or a plurality of apertures, wherein each aperture exposes a single nano-structure and is concentrically self-aligned with the end of the nano-structure, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures;

wherein the insulator and the embedding material are composed of the same dielectric material.

56. (Currently Amended) [[An electron source as recited in claim 39,]]An emission electron source comprising:

a cathode electrode disposed on a substrate, the cathode electrode for providing a source of electrons;

an emitter layer disposed over said cathode electrode and formed from a composition of an embedding material and one or a plurality of nano-structures embedded therein, the emitter layer having a surface, portions of the nano-structures protruding above the surface to emit electrons;

an insulator disposed over the emitter layer, the insulator having one or a plurality of apertures, each exposing at least the ends of the nano-structures in the emitter layer; and

a gate electrode disposed over the insulator and having one or a plurality of apertures, wherein each aperture exposes a single nano-structure and is concentrically self-aligned with the end of the nano-structure, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures;

wherein said insulator functions also as the embedding material.

57. (Currently Amended) An electron source as recited in claim [[39]]51,

wherein the cathode electrode is configured as a plurality of electrically isolated cathode electrodes, each for supplying an independent source of electrons;

wherein the gate electrode is configured as a plurality of electrically isolated electrodes, each intersecting with said cathode electrodes and having one or a plurality of apertures at each intersections, each gate electrode being operative to control the emission of electrons through the apertures along the gate electrode; and

wherein activation of a selected cathode and a selected gate electrode determines an intersection where the nano-structures emit electrons.

Claims 58 - 63. (Canceled)

64. (Previously Presented) A display comprising:

an electron source that includes:

a cathode electrode disposed on a substrate, the cathode electrode for providing a source of electrons;

an emitter layer disposed over said cathode electrode and formed from a composition of an embedding material and one or a plurality of nano-structures embedded

therein, the emitter layer having a surface, portions of the nano-structures protruding above the surface to emit electrons;

an insulator disposed over the emitter layer, the insulator having one or a plurality of apertures, each exposing at least the ends of the nano-structures in the emitter layer; and

a gate electrode disposed over the insulator and having one or a plurality of apertures, wherein each aperture exposes a single nano-structure and is concentrically self-aligned with the end of the nano-structure, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures; and

an anode plate including a transparent anode electrode disposed over a glass substrate and a phosphor screen disposed over the anode electrode, the anode plate being positioned opposite to said electron source with a vacuum gap disposed therebetween;

wherein electrons are emitted from said nano-structures by applying a voltage between said cathode and gate electrodes, and are made incident on said phosphor screen to make luminous said phosphor screen.

65. (Previously Presented) A display as recited in claim 64, wherein the nano-structures are substantially vertical.

66. (Previously Presented) A display as recited in claim 64, wherein the emitter-to-gate distance for each emitter is substantially less than one micrometer.

67. (Previously Presented) A display as recited in claim 64, wherein the nano-structures have a surface density substantially higher than $10^6/cm^2$.

68. (Previously Presented) A display as recited in claim 64,

wherein the cathode electrode is configured as a plurality of strip-like cathode electrodes extending substantially in the same direction in such a manner as to be spaced from each other at intervals in the transverse direction, each cathode strip for providing an independent source of electrons;

wherein the gate electrode is configured as a plurality of strip-like gate electrodes extending in such a manner as to intersect said plurality of cathode electrodes and to be spaced from each other at intervals in the transverse direction, and having one or a plurality of apertures at each intersection, each gate electrode for controlling the emission of electrons through the apertures along the gate electrode; and

wherein the anode electrode is configured as a plurality of strip-like anode electrodes each extending in such a manner as to be opposed to the corresponding one of said gate electrodes.

69. (Canceled)

70. (Currently Amended) [[An electron source as recited in claim 69,]] An emission electron source comprising:

a cathode electrode disposed on a substrate, the cathode electrode for providing a source of electrons;

an emitter layer disposed over said cathode electrode and formed from a composition of an embedding material and one or a plurality of nano-structures embedded therein, the emitter layer having a surface, portions of the nano-structures protruding above the surface to emit electrons;

an insulator disposed over the emitter layer, the insulator having one or a plurality of apertures, each exposing at least the ends of the nano-structures in the emitter layer; and

a gate electrode disposed over the insulator and having one or a plurality of apertures, wherein each aperture exposes a single nano-structure and is concentrically self-aligned with the end of the nano-structure, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures;

wherein said nano-structures in the emitter layer are truncated to substantially the same length, so that each exposed nano-structure in the gate aperture has substantially the same gate-to-emitter distance; and

wherein said nano-structures are truncated by chemical mechanical planarization.

71. (Currently Amended) An electron source as recited in claim [[39]]51, wherein said nano-structures are grown using a template and said template is at least part of the embedding material.

72. (Canceled)

73. (Canceled)

74. (Currently Amended) An electron source as recited in claim [[63]]51, wherein said nano-structures are truncated to substantially the same length.

75. (Previously Presented) A display as recited in claim 64, wherein said nano-structures in the emitter layer are truncated to substantially the same length, so that each exposed nano-structure in the gate aperture has substantially the same gate-to-emitter distance.

76. (New) A display as recited in claim 64, wherein the nano-structures have at least one of their three dimensions in the nanometer range.

77. (New) A display as recited in claim 64, wherein the nano-structures include nano-tubes, nano-wires, nano-fibers, and nano-cones.

78. (New) A display as recited in claim 64, wherein the nano-structures have a coating for enhanced field emission performance.

79. (New) A display as recited in claim 64, wherein the nano-structures comprise a nonconductive core and a conductive shell.

80. (New) A display as recited in claim 79, wherein the nonconductive core is made from one of wide band gap semiconductors, including diamond, BN, AlN, AlGaN, GaN, GaAs, SiC, and ZnO.

81. (New) A display as recited in claim 64, wherein said nano-structures are individually spaced apart.

82. (New) A display as recited in claim 64, wherein the embedding material is comprised of at least two layers.

83. (New) A display as recited in claim 82, wherein the first layer of the embedding material is conductive.

84. (New) A display as recited in claim 64, wherein the insulator and the embedding material are composed of the same dielectric material.

85. (New) A display as recited in claim 64, wherein said insulator functions also as the embedding material.

86. (New) A display as recited in claim 64, wherein said nano-structures are grown using a template and said template is at least part of the embedding material.

REMARKS

Claims 38-75 are pending in the above-referenced application. Claims 38-50, 53, 54, 57-63, 69 and 71-74 are rejected. Claim 51, 52, 55, and 56 are objected to. Claims 64-68, 70 and 75 are allowed.

In particular and according to the item numbering therein, the Office Action has:

In Items 1 and 2, rejected claims 39-42, 45-47 and 49 under 35 USC 102(e) as being anticipated by Raina (U.S. Patent No. 6,635,983);

In Item 3, rejected claims 39-47, 50, 53, 54, 57-63, 69 and 71-74 under 35 USC 102(e) as being anticipated by Lee (U.S. Publication No. 2005/0067935);

In Items 4 and 5, rejected claims 38 and 48 under 35 USC 103(a) as being unpatentable over Lee in view of Duan;

In Item 6, objected to claims 51, 52, 55,56, and 70 as being dependent on a rejected claims but indicating that the claims would be allowable if rewritten in independent form including the limitations of the base claim and any intervening claims; and

In Item 7, indicated that claims 64-68, 70, and 75 are allowed.

Regarding Items 1 and 2, Applicant has cancelled claim 39 without prejudice or surrender of subject matter so that a continuation can be filed, and changed the dependencies of claims 40-42 and 45-47 so that these claims depend from allowable claim 51 and the dependency of claim 49 to depend from allowable claim 64.

Regarding Item 3, Applicant has changed the dependencies of claims 43, 44, 53, 57 so that they now depend from allowable claim 51, and canceled claims 58-63, without prejudice or surrender of subject matter for later presentation in a continuation application. Applicant believes that, with the change of dependencies, claims 50 and 54 are now allowable. Applicant has also changed the dependencies of 71 and 74 so that they depend from claim 51 and has canceled claims 69, 72 and 73 without prejudice or surrender of subject matter.

Regarding Items 4 and 5, Applicant has canceled claim 38 without prejudice or surrender of subject matter and changed the dependency of claim 48 to depend from allowable claim 51.

Regarding Item 6, Applicant has rewritten claims 51, 55, 56, and 70 as independent claims according to the Examiner's suggestion. Claim 52 is presented as a claim depending from

claim 51, which is rewritten independent form according to the Examiner's suggestion. Regarding claim 70, the Examiner has indicated that the claim is allowable. However, claim 70, before these amendments, depended from rejected claim 69. Applicant believes the Examiner meant that the claim is objected to and, therefore, has rewritten claim 70 in independent form to include the limitations of claims 69 and 39 (the claim from which 69 depended). Applicant respectfully requests that the Examiner confirm Applicant's interpretation of this matter.

Finally, Applicant has added claims 76-86. These claims add limitations of the now allowable claims to claim 64, as follows. Claims 76, 77, 78 and 79 apply the limitations of claims 46, 47, 48, and (pre-amended) 51, respectively to claim 64. Claim 80 applies the limitation of (pre-amended) claim 52 to claim 79. Claims 81, 82, 84, 85, and 86 apply the limitations of claims 41, 53, (pre-amended) 55, (pre-amended) 56, and 71, respectively to claim 64. Claim 83 applies the limitation of claim 54 to claim 82. Applicant believes that these new claims do not introduce new matter and should be allowable as they depend from allowable claim 64 either directly or indirectly. Entry of these claims is respectfully requested.

CONCLUSION

Thus, in light of the above, having responded to each and every ground of rejection, and objection, Applicants respectfully request a notice of allowability for the currently pending, non-canceled and added claims.

Respectfully submitted,

Date: June 20, 2006

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